The western quest, First and Second Regional Acheuleans at Thomas-Oulad Hamida Quarries (Casablanca, Morocco).

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Abstract

In the Mio-Plio-Pleistocene sequence of Casablanca which covers the last six millions years, the oldest lithic assemblages are found in late Lower Pleistocene deposits, circa 1 Ma, in unit L of Thomas Quarry I, and consist of artefacts made from quartzite and flint. They document the First Regional Acheulean (FRA). More recent units from Thomas - Oulad Hamida and Sidi Abderrahmane Quarries yielded numerous remains of Homo heidelbergensis/rhodesiensis and lithic techno-complexes which characterize the Second Regional Acheulean (SRA) variability. This bi-partition of the Regional Acheuleans offers useful data for comparison with other areas of Africa and Middle East where hominids appeared and developed and should be considered in the debate about the earliest occupations of Europe.

The Maghreb is rich in testimonies of ancient populations. Numerous works carried out in Morocco since the beginning of the last century have yielded highly significant results about Quaternary stratigraphy and Prehistory, Palaeontology and Paleoanthropology as well (see Biberson, 1961a and b). However, many questions concerning the very first peopling of the extreme Northwest of Africa still remain unanswered. If an old human presence is indisputable and if we can assume that it could be even older, we still ignore how and when hominins came and which route they followed. Most of the propositions on this topic remains widely speculative.

The Casablanca coast has been slowly uplifting since the end of the Miocene and a huge piling of marine and continental formations has preserved an exceptional record (Fig. 1). The Casablanca long sequence begins nearly 6 Ma ago in the Upper Miocene and spreads over the Plio-Quaternary times with an extremely detailed registration of the global climatic cycles (Biberson 1961a; Stearns 1978; Raynal *et al.* 1995, 1999; Lefèvre 2000; Lefèvre and Raynal 2002).

In the upper Early and Middle Pleistocene portion of this late sequence, controlled excavations were performed in the archaeological sites of Sidi Abderrahmane and mainly Thomas-Oulad Hamida Quarries within the France-Morocco cooperative program *Casablanca* associating the French archaeological *"Mission littoral" (Ministère des Affaires Etrangères et du Développement International)* and the Moroccan National Institute of Archaeology and Heritage Sciences (Ministry of Culture). They have yielded rich lithic assemblages that represent the only North Africa First Acheulean recorded in an undisputable stratigraphic context (Raynal and Texier, 1989; Raynal *et al.* 2001). In previous papers, we used, without a great conviction, a classical subdivision of the regional Acheulean in three stages, i.e. lower, middle and upper Acheulean. We prefer here to consider two groups on stratigraphic and chronologic basis : First Regional Acheulean (FRA) and Second Regional Acheulean (SRA) (Raynal *et al.* in press). When necessary, we will refer to the different units of the *New Casablanca Lithostratigraphic Scale* (NCLS) which synthetize all observations and interpretations (Texier *et al.,* 1994, 2002; Lefèvre, 2000; Lefèvre and Raynal *op cit*) (Fig. 5).

In the introduction, we will briefly question the supposedly pre-Acheulean artefacts in Western Morocco and then present the key-sites for FRA and SRA at Casablanca.

Before the Acheulean: facts and geofacts

At Ahl-Al-Oughlam (108 m a.s.l.), formerly known as Déprez quarry (Biberson, 1961a and b), quarry works cut a paleo-shoreline containing some collapsed caves and shelters at the foot of a fossil cliff (*Ahl Al Oughlam morpho-sedimentary unit*, subunit 2 - Lefèvre and Raynal, *op cit*). Inside the fissures was discovered an extremely abundant faunal material which presents many similarities with those

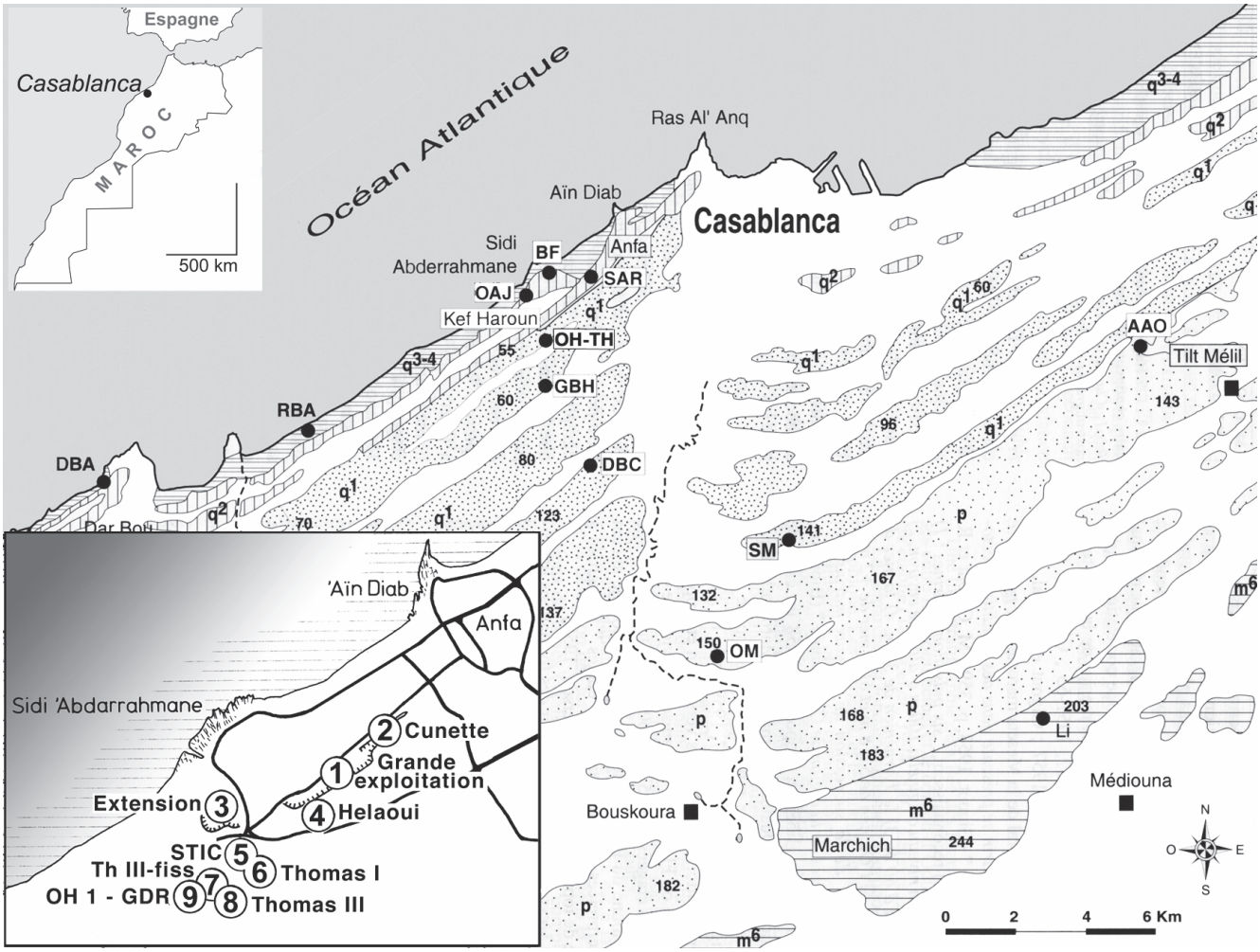

Figure 1: *General map of the Mio-Plio-Pleistocene formations presereved at Casablanca showing location of the main Acheulean localities : SAR for Sidi Abderrahmane Quarries and OH-TH for Oulad Hamida - Thomas Quarries (after Lefèvre and Raynal, 2002). Bottom left ; the sites of the Sidi-Abderrahman-Thomas-Oulad Hamida area.*

of Eastern Africa and implies that frequent exchanges took place before and during this period, at 2.4-2.5 Ma, during a great aridity crisis. Ahl al Oughlam has not yielded hominin remains, when at the same time East Africa abounds in sites with hominins (see Raynal *et al.* 1990 and Geraads *et al.* 1998 for more references). The Ahl-Al-Oughlam quarry was made famous by Biberson who found in its basal conglomerate (*Ahl Al Oughlam morpho-sedimentary Unit,* sub-unit 1 - Lefèvre and Raynal, *op cit*) elements referred to the local Pebble Culture: these pieces were actually geofacts shaped by the mechanical stir in the marine Pliocene deposits (Raynal and Texier, 1989); some geofacts have besides been discovered in other localities of Casablanca Pliocene deposits, at Bir As Smar quarry for example (*Oulad Malik morpho-sedimentary Unit* - Lefèvre and Raynal, *op cit*).

Moreover, all the series previously described as Pebble Culture, then as Pre-Acheulean (Biberson *op cit* and 1967), whether at Casablanca, in the Rabat and Rharb regions, or in the Tangier peninsula, proved to be either recent artefacts, or simply geofacts (see Raynal *et al.* 2002a and b for more details and references). Arbaoua gravel-beds supposed to have yielded the oldest Pebble-culture (Biberson, 1961a and b) « attest a period of erosion and high power transportation .../...which material were certainly affected by several reworking phases before their final setting up» (Aberkan, 1989: 250); this sedimentary context easily explains the few pieces discovered at the upper part of the gravels which, without in the slightest doubt, must be considered as geofacts. The revision of the Tardiguet er Rhala site (El Hajraoui, 1985; Texier *et al.* 1992) demonstrated that undoubtedly flaked pieces (Biberson, *op cit*) were included in colluviums of the weathered Pliocene substratum. The implements of the Salé plateau gravel-beds, mostly collected out of stratigraphic context, come from recent ferruginate units (Texier *et al. op cit*).

The series collected in undated colluviums at different places during civil engineering in Rabat (Biberson, 1961; Souville, 1973) and new ones cannot be considered as "Oldowan" artefacts. Neither can

the pebble-tools found at Casablanca in intertidal formations of middle-final Pleistocene? Maybe Middle-Upper reworking older fossil beaches and containing lower to middle Acheulean artefacts (basal conglomerate at Sidi-Abderrahmane-Extension for example), or those from colluviums resulting from recent morphogenetic phases reworking red soils, in which Acheulean and Aterian implements can be found: Sidi Abderrahmane-Grande exploitation quarry unit 4 (Raynal and Texier, 1984) and Schneider quarry at the Maarif-Aéroport for instance (Biberson *op. cit.*).

East of Rabat in the Mamora, recent works have demonstrated the existence of an Acheulean facies very poor in handaxes and roughly shaped on pebbles, as in layer 3 at Daya El Hamra (El Hajraoui *et al.* 1984; El Hajraoui 1985). In this area exist also Middle Stone Age facies ("Aterian") rich in pebble tools similar to those of the Chaperon Rouge I (Texier, 1986) and Chaperon Rouge II sites (Texier *et al.* 1982; Habboun, 1991).

Beyond these simple convergences of technologic facies, not a single element in Atlantic Morocco can nowadays substantiate the existence of Oldowan - in the complete sense of the term - both chronological and technological. This enlightens the differences observed by H. Roche (1980) when she compared Morocco and Olduvai series. As J. Chavaillon underlined (2003: 64-65) *« absence of handaxes in an assemblage is sometimes used to define such or such Palaeolithic, either older than Acheulean (Oldowan) or more recent. Yet, Lower Acheulean lithic assemblages, often poor in bifaces or Developped Oldowan in which archaic bifaces are very rarely represented can pose a labelling problem. These archaeological assemblages are besides both composed pebble-tools, among others, that H. Movius named « chopper » and « chopping-tool » after Chicago slaughterhouses. The presence or absence of one biface can type the assemblage, but this process is incorrect. If one handaxe or cleaver can at a pinch justify the attribution to the Acheulean, other criterions are needed to fully demonstrate a cultural belonging: technical, paleontological, palethnological... Moreover, an absence of some type of artefactt is no more no less does not allow any labelling. This « proof by absence » is rather often found in very serious books. There is no handaxes, it is then an Oldowan assemblage ! ».* It will therefore be advisable in the future to better examine the wide variability of the technocomplexes « with handaxes » of the Moroccan Acheulean and beyond of the African Acheulean, if possible along with palaeo-environmental and taphonomic data and even better, palaeo-anthropological ones.

The first regional Acheulean at Casablanca

Thomas Quarry layer L

In 1985, some Acheulean artefacts embedded in a yellow calcareous deposit under a very thick dunar complex were identified at the base of the south-eastern wall of the quarry (Raynal and Texier, 1989). An excavation began in 1989 and nowadays, Thomas Quarry I presents two interesting places: Layer L with FRA occupations, probably one million years even more, outcropping on 1000 m^2 and the Hominid Cave complex, noticeably more recent, on about 150 m^2 (fFig. 2).

Figure 2: *Thomas I Quarry. Layer L with FRAassemblage exposed and partly excavated and the Hominid Cave complex containing SRA assemblage open in the north wall (photo J.P. Raynal).*

In layer L, which is a complex of swampy-lagunal deposits with a sedimentation becoming eolian at the top, the archaeology is limited to occupations named L1 and L5, that is to say at the base (L1) an Acheulean rich in handaxes and trihedrons and at the top (L5), an assemblage with various cores (some biface-like ones), pebble-tools, flakes and some tools on flakes. Artefacts from Unit L1 have been subject to reworking processes linked to temporary water flows, as attested by their partial reorientation of and the washing-out of small bone splinters as well as micro-flakes. But in Unit L5, the smallest flakes are preserved in eolian sands. In Africa, assemblage composition varies with the tools position, in wadis major beds or in flood plain sediments for example and Thomas Quarry does not escape from this rule.

L1 and L5 implements are mainly shaped on local quartzites. In L1 assemblage we find true trihedrons and handaxes. Handaxes were shaped on pebbles and on flakes. Their morphology varies (Fig. 3) and corresponds to particular technics of production and uses: there are bifaces with terminal spatulate bevel, very pointed bifaces, picks… All

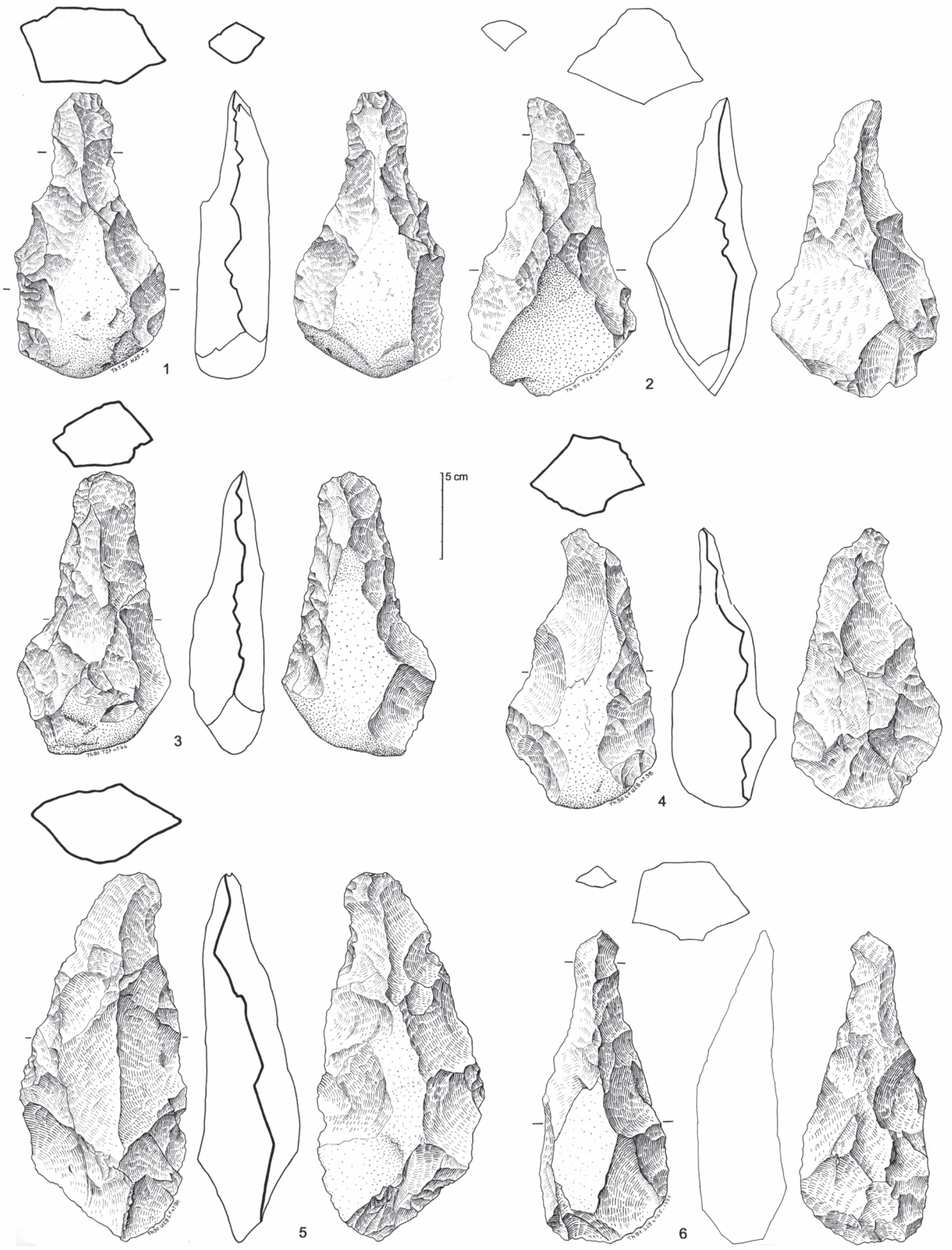

Figure 3: *Thomas I Quarry layer L: bifacial pieces of the FRA (drawings M. Hirbec-Raynal).*

these heavy duty tools morphologies may illustrate different subsistence activities (carcasses processing and butchery ?). We also find true spheroids and sub-spheroids, a huge variety of polyedrons/polyhedric cores and small flint pebbles broken by bipolar flaking; some of the flakes produced have been found and bear some use-wear but their function remains completely unknown. The knapping activities took place on the spot as demonstrated by the presence of complete or broken hammerstones. The flaking and shaping process characterize several chaînes opératoires: some are aimed to the production of large flakes (splitting of cobbles, prepared cores) and the shaping (façonnage) and retouching

of cleavers and hand-axes, others are dedicated to the production of flakes from polyedric (multifacial), peripheral, centripetal and true discoid cores. Most of the flakes have been used without retouching and the few retouched tools are denticulates (Raynal *et al.* 2001, 2002a and b). This assemblage is quite similar to that of Ubeidiya in Israel (Goren, 1981; Bar Yosef and Goren-Inbar, 1993) which is placed by biochronology ca. 1.4 Ma (Eisenmann *et al.* 1983) and possibly that of Kesem-Kebena in Ethiopia, dated ca. 1.0 Ma (Woldegabriel *et al.* 1992) but for which we lack detailed informations.

Several arguments, lithostratigraphic, paleontological and indications of inverse paleomagnetism, lead us to place the lower Acheulean of Thomas I (layer L1) between 1 and 1.4 millions years (Fig. 5). A SAR OSL date (Rhodes *et al.* 2006) gives an age estimate of 0,99 ± 0,21 Ma, which is in good agreement with other data.

We observe here a non-bifacial Acheulean facies *above* a classical Acheulean facies. Elsewhere in East Africa Oldowan assemblages can be relatively young, such as at NY 18 in Uganda, dated to 1.5 Ma, where artifacts are very similar to the industry of Thomas Quarry 1 Unit L5 (Texier, 1995), or even much younger, as at Bodo, where Oldowan assemblages are dated to ca. 0.64 Ma (Clark *et al.* 1994); some authors would say that we have here an assemblage of "Mode 1" above another of "Mode 2", but this is really poorly informative regarding the complexity of stone-use strategies of Plio-Pleistocene hominins and a more technologically oriented approach to Acheulean and Oldowan stone tool production is a better way of investigation (Semaw *et al.* 1997; Roche *et al.* 1999 ; de la Torre 2004 ; Delagnes and Roche 2005; Braun *et al.* 2008).

Possible cultural reasons for this variability among Acheulean assemblages must also be considered. When not due to the nature of the raw material, the variation may be connected with peculiar functional situations, such as hominid adaptive reactions to environmental and/or microenvironmental changes resulting from limited or global climatic changes, as pointed out in East Africa at Olorgesailie (Isaac 1966, 1977), Kilombe (Gowlett 1988) and Bodo (Clark *et al.* 1994).

Other sites

Sidi Abderrahmane Quarry at Casablanca, the classical site for Moroccan Ancient Prehistory, is a protected area since 1951. As soon as 1941, Neuville and Ruhlmann had discovered at its base, in layer M, an assemblage largely shaped on feldspathic sandstones that they qualified as « Clacto-Abbevilian ». It contained Acheulean forms (trihedrons, various handaxes, cleavers, spheroïds), large flakes (the "Clactonian" component) and various forms of pebble tools, associated with an abundant fauna but little varied, very fragmentary and dominated by *Hippopotamus* (Neuville et Ruhlmann, 1941a and b; Neuville, 1951).

This industry was considered for a long time as the oldest of the Acheulean sequence at Casablanca and represented stages I and II of the lower Acheulean, distinguished after the wear of artefacts (Biberson, 1961). This assemblage belongs probably to the bottom part of the Anfa Formation (Texier *et al.* 2002) with an age older than 0.5 Ma. It is a an Acheulean facies which wrongly « archaic »aspect is undoubtedly the expression of a simplified technology massively oriented to large flakes production (direct or bipolar) (Mohib, 1991) and applied to an abundant raw material at disposal for butchery purposes and carcasses exploitation activities. It marks the end of the lower Acheulean, as does the assemblage of the nearby STIC Quarry.

Layer D of the STIC quarry was located beyond the south extremity of Sidi Abderrahmane-Grande Exploitation quarry. Its layer D yielded a rich material flaked on quartzites rich in various types of handaxes with cleavers, trihedrons, bifacial cores (SSDA), polyhedral (multifacial) cores and a few bolas, which allowed to define the stage III of the lower Acheulean (Biberson, 1961b). Some of these pieces are *in every respect identical* to those of the L layer of Thomas I Quarry overhanging the STIC. We could suspect erosional processes of layer L and a natural mixing of series, sustained by the existence of a karstic gallery, but this is now impossible to check since the STIC Quarry has been recently completely filled up. The associated faunal remains belong in their majority to big mammals (rhinoceros, hippopotamus and elephant). Tools and fauna point then in favour of a site of butchery and carcass processing.

Layer M at Sidi Abderrahmane and STIC layer D represent the most recent facies of the FRA. They both belong to the bottom units of the *Anfa Formation* (NCLS), older than 0.5 Ma (isotopic stages 14/16). This is confirmed by an age of 492 ± 57 ka (Rhodes *et al.* 2006) obtained from the bottom of Member 2 of the *Anfa Formation* (NCLS) on backshore sands.

The second regional Acheulean at Casablanca

In Thomas Quarries I and III, a polyphase shoreline was hollowed in the cemented Members 1 and

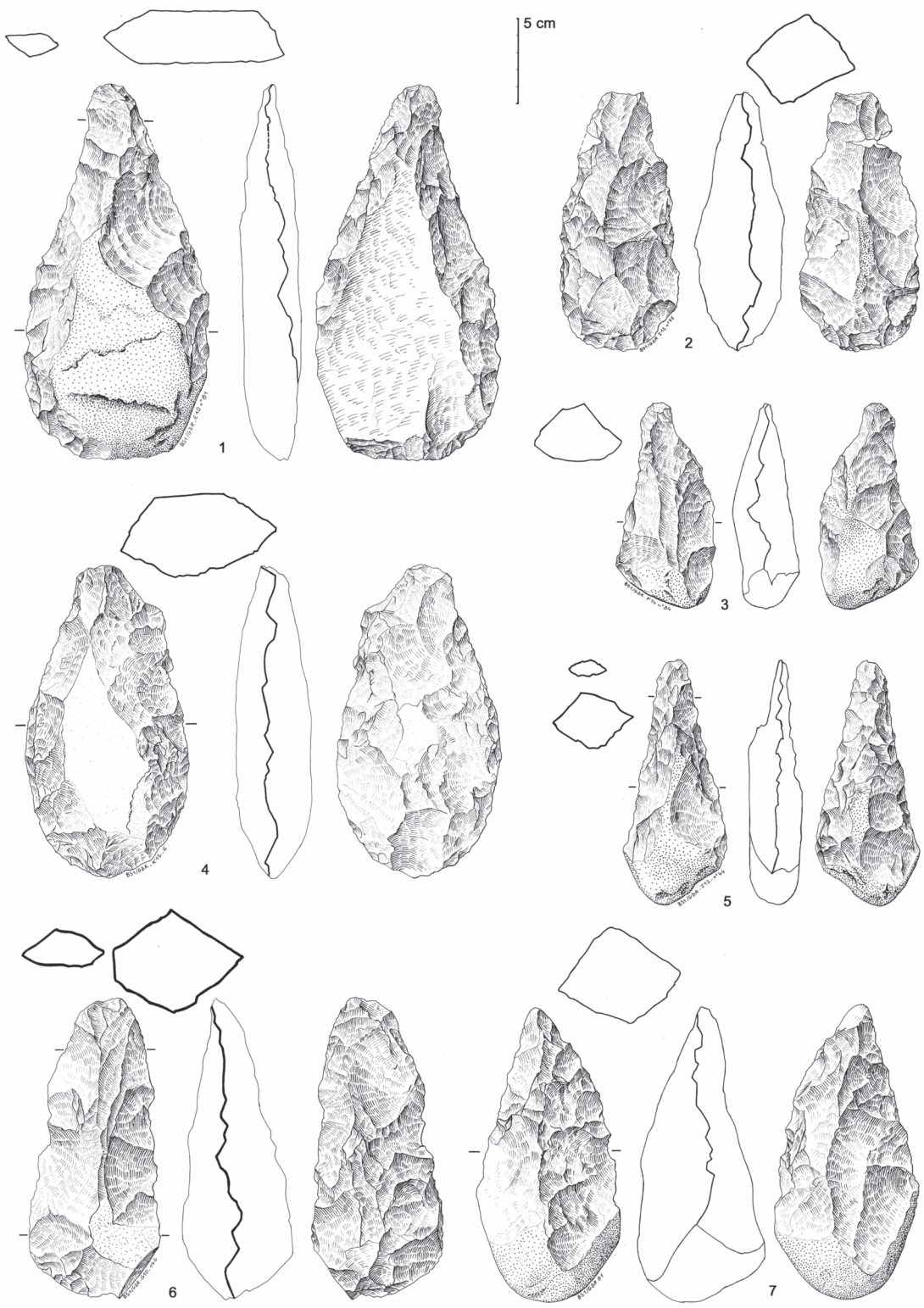

Figure 4: *Oulad Hamida 1 Quarry - Rhinoceros cave, lower layer: bifaces of the SRA (drawings M. Hirbec-Raynal).*

2 of the *Oulad Hamida Formation* (NCLS) during two successive high marine stands (MIS 21 and 19?). Lithic assemblages, fauna and hominid fossils were discovered in the caves associated to this shoreline. At Sidi Abderrahmane, some assemblages and hominid fossils were discovered in caves associated to the "Anfatian" shoreline (Biberson, 1961a and b): the most famous are the Littorines Cave in which were discovered some fragments of the Sidi Abderrahmane human fossil (Biberson, 1956), the Bears Cave and Cap Chatelier. Actually, two marine stands and their deposits (Members 3 and 4 of the Anfa Formation) (Texier *et al.* 2002) have been recorded using the same polyphase notch during high marine stands related to MIS 13 and 11. All assemblages from these sites and that of Sidi Abderrahmane-Extension characterize the SRA in its variability.

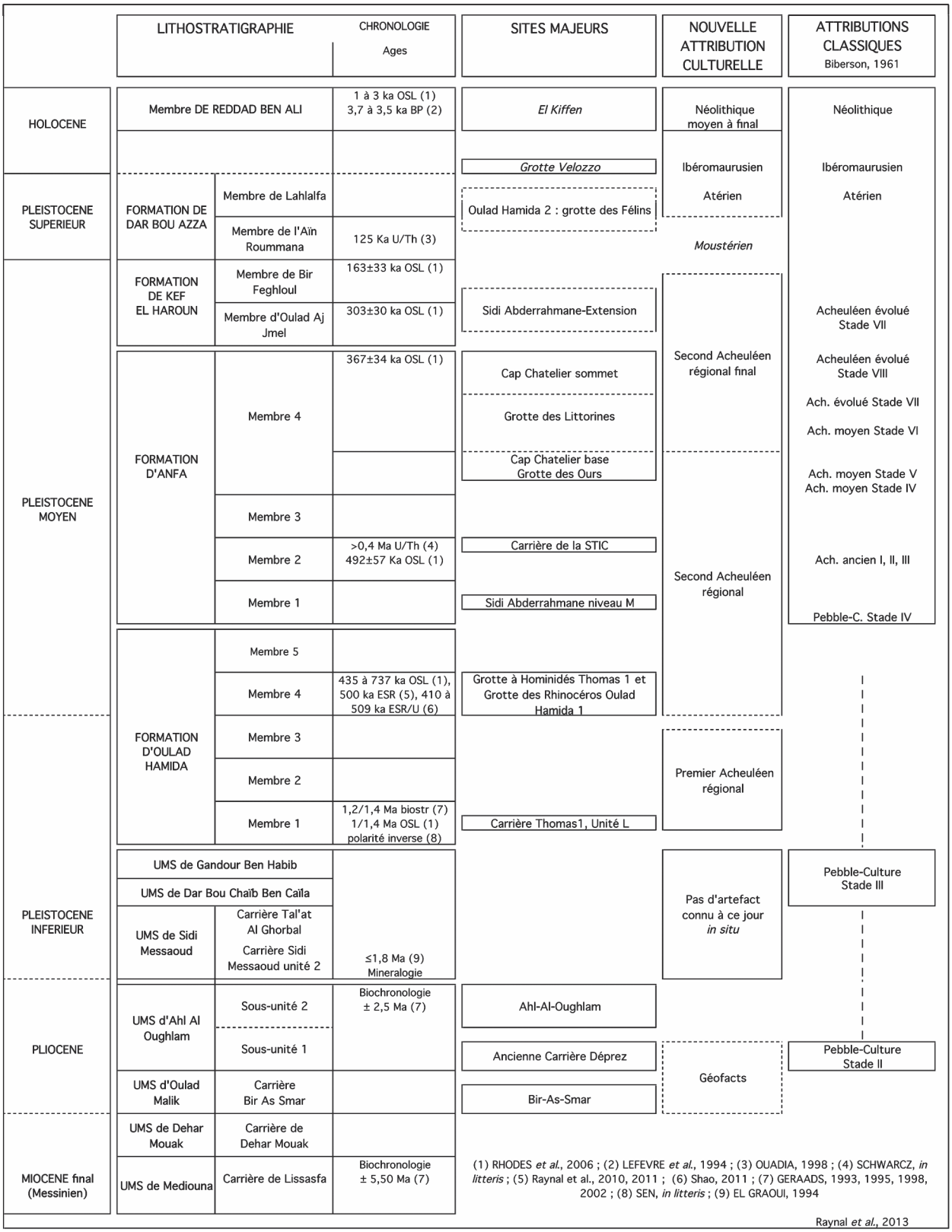

Figure 5: *The Casablanca archaeological evidences replaced within the New Casablanca Lithostratigraphic Scale (NCLS).*

Hominid Cave at Thomas Quarry I

Disorganised collections of fauna and industry occurred in this quarry until 1963, when a human mandible was discovered by Philippe Beriro (Ennouchi 1969). More human fossils have been discovered since and are referred to *Homo heidelbergensis/rhodesiensis* (Raynal *et al.* 2010). As observed in ancient collections (Geraads *et al.* 1980) and confirmed by modern excavations, the lithic assemblage is manufactured on various quartzites with very few flint objects. It consists mainly in pebble-tools (choppers and chopping-tools) and core tools, flakes and very rare small bifaces. The fauna is very well pre-

served and is dominated by carnivores (Bernoussi, 1994, 1997) which are the first agents for the bone accumulation in the site. In some parts of the cave, artefacts, fauna remains and human fossils have been mixed by run-off. OSL measurements provided an age estimate ca 0.4 Ma (Rhodes *et al.* 2006) and a direct dating at 0.5 Ma was obtained on one hominid premolar (Raynal *et al.* 2010).

Rhinoceros Cave at Oulad Hamida 1 Quarry

This site was discovered in 1991 in an extension of the former Thomas III Quarry (Raynal *et al.* 1993; Rhodes *et al.* 1994). It is a marine cave belonging to one of the paleo-shores subsequent to the Member 1 of the *Oulad Hamida Formation* (NCLS) and thus shaped prior to the Anfa Group edification.

The assemblage was manufactured mainly with different varieties of quartzite and a few flint nodules (Fernandes *et al.* in press). The macro-industry comprises handaxes of various morphologies and dimensions (Fig. 4), as well as rare cleavers and pebble tools; the micro-industry is mainly made of raw flakes that, apart from those coming from the shaping of bifacial pieces, were produced by discoid (unifacial and bifacial), polyhedric (multifacial) and SSDA flaking, not any evidence of Levallois flaking has for now been identified; retouched flakes are rare, notches and denticulates are a majority and little diversified. This is a rather banal and frequent composition described in the literature for various Acheulean sites in Africa but also Middle Pleistocene European ones. Fire still does not seem to be used: not any burnt bones remain nor charcoal was discovered.

The fauna proved to be extremely rich in white rhinoceros possibly exploited by man, even if many carnivores played a part in this accumulation. Nearly fifty Vertebrate species were discovered indicating a noticeably more arid climate than now (Geraads, 1993b, 1994; Bernoussi, 1994, 1997). The lithostratigraphy, microfauna and datings lead to place this assemblage close to that of the Hominid Cave of Thomas I Quarry. ESR datings however indicate an age estimate whithin the range of 435-737 ka, limits provided by early and linear uptake model ages, respectively (Rhodes *et al.* 2006).

Bears cave at Sidi Abderrahmane

The main part of the filling of this cavity is a marine deposit forming the lower part of Member 4 of the *Anfa Formation* (NCLS). Prior to its setting, the back of the cave was inhabited in alternance by carnivores and humans. Tidal process have mixed former beach and cave deposits and pushed them several times inside the cavity.

The archaeological material shows different degrees of wear. It was considered as middle Acheulean (stage V) by P. Biberson (1961b). Bears Cave assemblages show the use of very large discoid cores for the production of large flakes (blanks for handaxes and cleavers) and some smaller and of bifacial type, the absence of Levallois core and the production of complete or partial bifacial pieces, often symmetric (Mohib, 2001). This Acheulean is probably contemporaneous with the top of Member 3 of the *Anfa Formation* (NCLS) referred to MIS 12.

Sidi Abderrahmane Cunette

In the northern part of Sidi Abderrahmane quarry, Littorines cave was discovered and yielded in 1955 in unit F the fragmentary remains of the Sidi Abderrahmane *Atlanthropus* (Biberson, 1956). The assemblage was attributed to the Middle Acheulean (stage VI) by P. Biberson (1961b).

Along the west wall of the « Cunette », Cap Chatelier is another site belonging to the "Anfatian" shoreline. The assemblage from Biberson's layer D2 comprises bifaces of various dimensions and morphologies, sometimes very thin, some cleavers and a flake production processed from discoid and levallois with preferential removal. It was considered as evolved Acheulean (stage VIII) by P. Biberson (1961b). Cap Chatelier deposits are capped by an uppermost dune visible in the Cunette wall, which provided an age estimate of 376 ± 34 ka (Rhodes *et al.* 2006), in accordance with the lithostratigraphic context.

Sidi Abderrahmane-Extension

Beyond the southwestern extremity of Sidi Abderrahmane-Grande Exploitation was Sidi Abderrahmane-Extension Quarry. Pierre Biberson had made of it the type locality for his evolved Acheulean (stage VII) that he placed before layer D2 of Cap Chatelier. Excavations have shown the existence of two archaeological layers. The upper layer (4 base) yielded an abundant material rich in handaxes of various types, often with a terminal bevel. Along with discoid unifacial and bifacial cores there are a few predetermined-cores with preferential removal. Lithostratigraphic studies demonstrated that Sidi Abderrahmane-Extension deposits lie at the top of the *Oulad Aj Jmel Member of the Kef El Haroun Formation* (NCLS) which gives an age estimate of 303 ± 30 ka (Rhodes *et al.* 2006). At the moment, the assemblage of layer 4 base at Sidi Abderrahmane Extension is the youngest Acheulean in the Casablanca sequence.

Conclusions

The Pre-Acheulean ancient stages recognized by Biberson do not exist and they are actually geofacts, or more recent industries: there is no yet known Oldowan (in the chronological sense of the word) in Atlantic Morocco.

The FRA is only known in open air sites with exploitation of very big fauna (Thomas I L1, STIC, Sidi Abderrahmane M...). Assemblages are rich in bifacial macro-implement and cleavers or in small flaking products (Thomas I L5). The morphological variability of the retouched parts expresses a predetermination for specialised activities. Finally, many bifacial pieces are managed as cores, even as percussors, and bear in embryo the schemes of preparation and exploitation of cores with predetermined posterior flakes.The First Acheulean occurs at a least ca 1 Ma at Thomas I Quarry (unit L), may be sooner (1.4 Ma at most) and its last terms are represented by the assemblages from Unit M of Sidi Abderrhamane-Grande Exploitation and from Unit D at the STIC quarry, both older than 0.5 Ma.

Sharon (2007, 2010) identified a stage within the Acheulean techno-complex, called Large Flake Acheulian (LFA), as a "distinct segment in the Acheulian techno-complex that is technologically and typologically distinguishable from others" (Sharon 2010, p. 228)

LFA assemblages from a very wide geographical and even chronological range are grouped together, following these criteria.

- most part of the bifaces blanks are large flakes detached from giant cores;
- giant cores were flakes through predetermined methods (Sharon 2009);
- large flake production shows a propensity for coarse-grained rock types rather than from fine-grained raw materials (Sharon 2008);
- most bifaces and cleavers were shaped with minimal retouch of the ventral face thinning the flake blank's butt-bulb, given the high degree of predetermination of the blanks;
- LFA assemblages contain significant frequencies of cleavers (Tixier 1956);
- most bifaces have pointed tips, whereas broad-tipped ovate bifaces are rare.

LFA is predated in Africa and Levant by a phase of early Acheulean, older than 1 Ma, when large flakes do not constitute a primary technological praxis and cleavers are absent. Following Sharon, the lithic series from Unit L of Thomas 1 Quarry corresponds to this pre-LFA stage. LFA appears in East Africa around 1 Ma and has a long duration, up to the very last stages of its existence.

On the contrary, in the Sahara, North Africa and the Iberian Peninsula, the chronological and cultural sequences of the LFA are unclear. As pointed by Sharon (2010), absolute dates are rare, and the cultural sequences are largely based on typological correlations.

Large flake blanks are a major component in all of the North African Middle Pleistocene sites studied by Sharon (Sidi Abderrahman, Grotte des Ours, STIC Quarry, Ternifine, Tachenghit) and most of these sites included cleavers as a significant part of their assemblage.

In addition, Sharon (2011) assessed that Iberian Middle Pleistocene Acheulean finds its origin in the Northern African one. This hypothesis is based on the presence of a specific technical behaviour, i.e. the *éclat d'entame* method, identified firstly at Ternifine. "A cobble was struck once at a precise location on the cortex at an obtuse angle…. The strike produced a blank that was perfectly suited to handaxe production…, with minimal necessity, if at all, of secondary retouch. This method was highly controlled, due to the meticulous attention paid both to raw material block size and shape selection and to the systematic removal of a single, preplanned primary flake" (Sharon 2011, p. 128). In a second stage of production, Kombewa flakes were detached from entame flakes. Cleavers manufactured from these blanks have been reported in the aforementioned Acheulean assemblages from North Africa and from the Iberian Peninsula (Alimen 1978; Balout *et al.* 1967; Santonja and Villa 1990; Raposo and Santonja 1995; Mourre 2003; Méndez-Quintas *et al.* 2006; Arroyo and Torre, 2013; García-Moreno *et al.* 2014; Sharon and Barsky in press). Nevertheless, as pointed by Santonja and Villa (2006), the known Middle Pleistocene sites of the Iberian Peninsula appear in fluvial deposits, whose chronostratigraphies are debatable. LFA had disappeared by 0.5 Ma from North Africa, and from Levant as well, when non-large flake based Acheulean industries emerge with a high preference for flint as raw material for bifaces manufacture.

The SRA presents varied situations. Assemblages from caves (Thomas I Hominids cave, Rhinoceros Cave upper layer) are rich in small flaking, cores and core?tools (including flaked cobbles with SSDA method) and associated with an abundant fauna in which medium and small size mammals have been hunted and scavenged. Some knapping workshops

exist in open-air localities (Sidi Al Khadir-Helaoui), but may be so-called considering the absence of preserved faunal remains. The SRA is very polymorph, represented as soon as 0.5 Ma in Homind Cave at Thomas I Quarry and in layers of Rhinoceros Cave. It develops during MIS 11 represented at Sidi Abderrahmane by the Bears Cave and Littorines Cave assemblages. The more recent terms show a common use of Levallois flaking, prior to 0.35 Ma at Cap Chatelier (D2) and ca 0.3 Ma at Sidi Abderrahmane-Extension upper layer.

This exceptionnal sequence must from now on, considering its richness, be taken into account at the same rank than those from Eastern and Southern Africa, Europe, Middle East or Asia.

The chronological framework necessary for correlations with other African zones for now on not only rests on a reliable biostratigraphical scale, that an intensification of researches will make more detailed (figure 5), but has been recently strengthened by a series of absolute datings by different methods. An effort has still to be made to obtain more datings and to establish a paleomagnetic framework. Hominins fossils are still rare but new findings have recently occurred in an stratigraphic context: from the point of view of human evolution, Thomas I and Oulad Hamida 1 quarries are undisputably the most important site complex in North West Africa.

Future researches will have to establish the nature of the relations with East Africa, Middle East and more widely Eurasia.

References

Aberkan M. (1989) - *Etude des formations Quaternaires des marges du bassin du Rharb (Maroc nord occidental).* Thèse, Université de Bordeaux 1, 290 p.

Alimen M.H. (1978) - *L'évolution de l'Acheuléen au Sahara Nord-Occidental (Saoura-Ougarta-Tabelbala).* Paris, CNRS.

Arroyo A., Torre I. de la (2013) - Acheulean large flake technology in Campo de Calatrava (Ciudad Real, Spain). *Archaeology, Ethnology and Anthropology of Eurasia* 4:2-10.

Balout L. (1955) - *Préhistoire de l'Afrique du Nord.* Paris, Arts et Métiers graphiques.

Bar Yosef O. & Goren-Inbar N. (1993) - *The Lithic Assemblages of Ubeidiya: A Lower Palaeolithic Site in the Jordan Valley.* QEDEM 34, 280 p.

Bernoussi R. (1994) - *Etude d'une taphocénose Pleistocène. Exemple de la Grotte des Rhinoceros (Carrière Oulad Hamida 1, Casablanca, Maroc).* Mémoire de DEA, Université de Bordeaux 1, 101 p.

Bernoussi R. (1997) - *Contribution à l'étude palaeontologique et observations archéozoologiques pour deux sites du Pleistocène moyen du Maroc atlantique : grotte à Hominidés de la carrière Thomas I et de la grotte des Rhinocéros de la carrière Oulad Hamida 1* (Casablanca, Maroc). Thèse de l'Université de Bordeaux 1, n° 1711, 263 p.

Biberson P. (1956) - Le gisement de l' « Atlanthrope » de Sidi Abderrahmane (Casablanca), *Bulletin d'Archéologie Moroccaine* 1:39-92.

Biberson P. (1961a) - *Le cadre palaeogéographique de la Préhistoire du Maroc atlantique.* Publications du Service des Antiquités du Maroc, Rabat, fascicule 16, 235 p.

Biberson P. (1961b) - *Le Palaeolithique inférieur du Maroc atlantique.* Publications du Service des Antiquités du Maroc, Rabat, fascicule 17, 544 p.

Biberson P. (1967) - Some aspects of the Lower Palaeolithic of Northwest Africa. In: W.W. Bishop & J. Desmond-Clark (eds.), *Background to Evolution in Africa.* Chicago and London, The University of Chicago Press, p. 447-475.

Braun D.R., Tactikos J.C., Ferraro J.V., Arnow S.L., Harris J.W.K. (2008) - Oldowan reduction sequences: methodological considerations. *Journal of Archaeological Science* 35:2329-2345.

Chavaillon J. (2003) - La preuve en Préhistoire ou les limites de la crédibilité. In: O. Jacob (ed.), *Le Temps des savoirs, Revue interdisciplinaire de l'Institut universitaire de France, n°5, La Preuve,* p. 53-73.

Clark J.D., Heinzelin J. de, Schick K.D., Hart W.K., White T.D., Woldegabriel G., Walter R.C., Suwa G., Asfaw B., Vrba E., Selassie Y.H. (1994) - African *Homo erectus:* Old radiometric Ages and Young Oldowan Assemblages in the Middle Awash Valley, Ethiopia. Science 264:1907-1910.

Delagnes A., Roche H. (2005) - Late Pliocene hominid knapping skills: the case of Lokalalei 2C, West Turkana, Kenya. *Journal of Human Evolution* 48:435-472.

Eisenmann V., Ballesio R., Beden G., Faure M., Geraads D., Guerin C., Heintz E. (1983) - Nouvelle interpretation biochronologique des grands mammifères d'Ubeidiya, Israël. *Geobios* 16(5):629633.

El Hajraoui M.A. (1985) - *Les industries préhistoriques de la region de la Mamora dans leur contexte géologique et palaeopédologique.* Thèse 3ème cycle, Université de Bordeaux 1, 185 p.

Ennouchi E. (1969) - Découverte d'un Pithécanthropien au Maroc. *C. R. Acad. Sci. Paris, série* D 269:763-765.

Fernandes P., Raynal J.P., Mohib A. (in press) - L'exploitation des ressources minérales par les hommes du Second Acheuléen régional (Grotte des Rhinocéros, Casablanca, Maroc). In: J.P. Raynal & A. Mohib (eds), *Préhistoire de Casablanca I. La Grotte des Rhinocéros (fouilles 1991 et 1996).* VESAM VI. Rabat, Royaume du Maroc Ministère de la Culture Institut National des Sciences de l'Archéologie et du Patrimoine, p. 145-154.

García-Medrano P., Ollé A., Mosquera M. (2014) - The earliest Acheulean technology at Atapuerca (Burgos, Spain): oldest levels of the Galería site (GII Unit). *Quaternary International* 353:170-194.

Geraads D. (1993) - Middle Pleistocene Crocidura (Mammalia, Insectivora) from Oulad Hamida I, Morocco, and their phylogenetic relationships. *Proceedings van der Koninklijke Nederlandse Akademie van Wetenschappen* 96(3):281-294.

Geraads D. (1994) - Rongeurs et Lagomorphes du Pleistocène moyen de la "Grotte des Rhinocéros", carrière Oulad Hamida 1, à Casablanca, Maroc. *N.Jb.Geol.Pal., Abh.* 191(2):147-172.

Geraads D., Amani F., Raynal J-P., Sbihi-Alaoui F.Z. (1998) - La faune de Mammifères du Pliocène terminal d'Ahl al Oughlam, Casablanca, Maroc. *C. R. Acad. Sci., Sciences de la Terre et des Planètes* 326:671-676.

Geraads D., Beriro P., Roche H. (1980) - La faune et l'industrie des sites à Homo erectus des carrières Thomas (Casablanca, Maroc). Précisions sur l'âge de ces Hominidés. *C .R. Acad. Sic. Paris* D 291:195-198.

Goren N. (1981) - *The lithic assemblages of the site of Ubeidiya, Jordan valley.* Ph. D. thesis, Hebrew Univerity of Jerusalem.

Gowlett J.A.J. (1988) - A case of developed Oldowan in the Acheulean? *World Archaeology* 20:13-26.

Habboun A. (1991) - *Etude de l'industrie lithique du Chaperon Rouge II.* Mémoire de fin d'Etude du IIè Cycle des Sciences de l'Archéologie et du patrimoine, INSAP, Rabat, 156 p. et annexes.

Isaac G.L. (1966) - New evidence from Olorgesailie relating to the character of Acheulian occupation sites. In: L.D. Cuscoy (ed.), *Actas del V Congreso Panafricano de Prehistoria y de Estudio del Cuaternario.* Publicaciones del Museo Arqueologico Santa Cruz de Tenerife, Tenerife 6, p. 135-145.

Isaac G.L. (1977) - *Olorgesailie: Archaeological Studies of a Middle Pleistocene Lake Basin in Kenya.* University of Chicago Press, Chicago.

Lefèvre D. (2000) - *Du continent à l'océan. Morphostratigraphie et palaeogéographie du Quaternaire du Maroc atlantique. IIe partie: le modèle casablancais.* Thèse d'Habilitation à diriger des recherches, vol. 3, Université de Montpellier III, p. 100-308, 47 fig., 2 tab.

Lefèvre D. & Raynal J.P. (2002) - Les formations plio-Pleistocènes de Casablanca et la chronostratigraphie du Quaternaire marin du Maroc revisitées. *Quaternaire* 13(1):9-21.

Mendez-Quintas E., Villar Quinteiro R., Santonja M., Perez-Gonzalez A., Ledo Bernardez M. (2006) - Valoración preliminar del yacimiento paleolítico de Portomaior, as Neves, Galicia. In: J.M. Maillo, E. Baquedano (eds.), *Miscelánea en homenaje a Victoria Cabrera, Zona Arqueológica 7*, p. 184-193.

Mohib A. (1991) - *Contribution à l'étude du Palaeolithique ancien de Casablanca : l'outillage du niveau M de Sidi Abderrahmane (fouilles Neuville et Rulhmann).* Mémoire de fin d'Etudes de l'INSAP, 126 p., 68 fiches techno-typologiques.

Mohib A. (2001) - *L'Acheuléen de la grotte des Ours à Sidi Abderrahmane (Casablanca, Maroc) dans son contexte régional (fouilles anciennes et recent).* Thèse de l'Institut National des Sciences de l'Archéologie et du Patrimoine, Rabat, 348 p.

Mourre V. (2003) - *Implications culturelles de la technologie des hachereaux.* PhD thesis, Université de Paris X-Nanterre.

Neuville R. & Ruhlmann A. (1941a) - *La place du Paléolithique ancien dans le Quaternaire marocain.* Hespéris 8. Casablanca, Librairie Farairre, 156 p.

Neuville R. & Ruhlmann A. (1941b) - *Note sur les transgressions marinee Quaternaires du littoral atlantique du Maroc.* Bulletin de la Société Préhistorique Française 38:205-207.

Neuville R. (1951) - Le site clacto-Abbevillien tsyacien, acheuldéen et micoquien de Sidi Abderrahmane, histoire d'un classement. *Bulletin de la Société préhistorique française,* 48, 101-108.

Raposo L., Santonja M. (1995) - The earliest occupation of Europe: The Iberian Peninsula. In: W. Roebroeks, T.V. Kolfschoten (eds.), *The earliest occupation of Europe. Leiden,* University of Leiden, p. 7-25.

Raynal J.P. & Texier J.P. (1984) - *Sidi Abderrahmane carrière Schneider «limons rouges». In: Activités de la mission préhistorique et palaeontologique française au Maroc. Années 1981-1982.* Bulletin d'Archéologie Morocaine 15, p. 42-44.

Raynal J.P. & Texier J.P. (1989) - Découverte d'Acheuléen ancien dans la carrière Thomas I à Casablanca et problème de l'ancienneté de la présence humaine au Maroc. *C. R. Acad. Sci.* Paris 308, series II, 1743-1749.

Raynal J.P., Mohib A., Lefevre D. (2016) - Casablanca des origines. In: J.P. Raynal & A. Mohib (eds.), Préhistoire de Casablanca. I - *La Grotte des Rhinocéros (fouilles 1991 et 1996),* VESAM VI. Rabat, Royaume du Maroc Ministère de la Culture Institut National des Sciences de l'Archéologie et du Patrimoine, p. 11-33.

Raynal J.P., Lefevre D., Geraads D., El Graoui M. (1999) - Contribution du site palaeontologique de Lissasfa (Casablanca, Maroc) à une nouvelle interpretation du Mio-Pliocène de la Méseta. *C. R. Acad. Sci. Paris, Series 2A, Sciences de la terre et des planètes* 329:617-622.

Raynal J.P., Magoga L., Sbihi-Alaoui F.Z., Geraads D. (1995) - The Earliest Occupation of Atlantic Morocco: The Casablanca Evidence. In: W. Roebroeks & T. van Kolfschoten (eds.), *The earliest occupation of Europe.* Leiden, University of Leiden, p. 255-262.

Raynal J.P., Geraads D., Magoga L., Elhajraoui A., Texier J.P., Lefevre D., Sbihi-Alaoui F.Z. (1993) - La grotte des Rhinocéros (Quarry Oulad Hamida 1, anciennement Thomas III, Casablanca), nouveau site Acheuléen du Maroc atlantique. *C. R. Acad. Sci. Paris, series 2A, Sciences de la terre et des planètes* 316:1477-1483.

Raynal J.P., Sbihi Alaoui F.Z., Geraads D., Magoga L., Mohib A. (2001) - The earliest occupation of North-Africa: the Moroccan perspective. *Quaternary International* 75:65-75.

Raynal J.P., Sbihi-Alaoui F.Z., Magoga L., Mohib A., Zouak M. (2002a) - Casablanca and the early occupation of north-atlantic Morocco. *Quaternaire* 13(1):65-77.

Raynal J.P., Sbihi-Alaoui F.Z., Magoga L., Mohib A., Zouak M. (2002b) - The Lower Palaeolithic sequence of atlantic Morocco revisited after recent excavations at Casablanca. *Bulletin d'Archéologie marocaine* 20:44-76.

Raynal J.P., Sbihi-Alaoui F.Z., Mohib A., El Graoui M., Lefevre D., Texier J.P., Geraads D., Hublin J.J., Smith T., Tafforeau P., Zouak M., Grün R., Rhodes E.J., Eggins S., Daujeard C., Fernandes P., Gallotti R., Hossini S., Queffelec A. (2010) - Hominid Cave at Thomas Quarry I (Casablanca, Morocco) : recent findings and their context. *Quaternary International* 223-224:369-382.

Raynal J.P., Texier J.P., Geraads D., Sbihi-Alaoui F.Z. (1990) - Un nouveau gisement palaeontologique plio-Pleistocène en Afrique du Nord: Ahl Al Oughlam (ancienne quarry Déprez) à Casablanca (Maroc). *C. R. Acad. Sci. Paris, series 2A, Sciences de la terre et des planètes* 310:315-320.

Rhodes E., Raynal J.P., Geraads D., Sbihi-Alaoui F.Z. (1994) - Premières dates RPE pour l'Acheuléen du Maroc atlantique (Grotte des Rhinocéros, Casablanca). *C. R. Acad. Sci. Paris, series 2A, Sciences de la terre et des planètes* 319:1109-1115.

Rhodes E.J., Singarayer J.S., Raynal J.P., Westaway K.E., Sbihi-Alaoui F.Z. (2006) - New age estimations for the Palaeolithic assemblages and Pleistocene succession of Casablanca, Morocco. *Quaternary Science Reviews* 25:2569-2585.

Roche H., Delagnes A., Brugal J.-P., Feibel C.S., Kibunjia M., Mourre V., Texier P.J. (1999) - Early hominid stone tool production and technical skill 2.34 Myr ago in west Turkana, Kenya. *Nature* 399:57-60.

Santonja M., Villa P. (1990) - The Lower Paleolithic of Spain and Portugal. *Journal of World Archaeology* 4:45-94.

Santonja M., Villa P. (2006) - The Acheulean of Western Europe. In: N. Goren-Inbar & G. Sharon (eds.), *Axe age: Acheulean tool-making from quarry to discard.* London, Equinox, p. 429-478.

Sharon G. (2007) - *Acheulean large flake industries: Technology, chronology, and significance.* BAR (British Archaeological Reports) International Series 1701. Oxford, Archaeopress.

Sharon G. (2008) - The impact of raw material on Acheulian large flake production. *Journal of Archaeological Science* 35:1329-1344.

Sharon G. (2009) - Acheulean giant cores technology—a worldwide perspective. *Current Anthropology* 50:335-367.

Sharon G. (2010) - Large flake Acheulean. *Quaternary International* 223-224:226-233.

Sharon G. (2011) - Flakes Crossing the Straits? Entame Flakes and Northern Africa-Iberia Contact During the Acheulean. *African Archaeological Review* 28:125-140.

Sharon G. & Barsky D. (in press) - The emergence of the Acheulian in Europe - A look from the east. *Quaternary International,* [Online] 411, Part B:25-33. Available from: http://dx.doi.org/10.1016/j.quaint.2015.11.108 [Accessed 3rd February 2017].

Semaw S., Renne P., Harris J.W.K., Feibel C.S., Bernor R.L., Fesseha N., Mowbray K.M. (1997) - 2.5-Million-year-old stone tools from Gona, Ethiopia. *Nature* 385:333-336.

Souville G. (1973) - *Atlas préhistorique du Maroc ; I, le Maroc atlantique.* Etudes d'antiquités africaines, éditions du CNRS, Paris, 368 p.

Stearns C.E. (1978) - Pliocene-Pleistocene emergence of the Moroccan Meseta. *Geological Society of American Bulletin* 89:1630-1644.

Texier J.P., Debenath A., Raynal J.P. (1982) - *Une stratigraphy complexe du Quaternaire continental Moroccan: le Chaperon Rouge II à Rabat.* 9ème Réun. an. Sci. Terre. Paris, Soc. Géol. Fr. Ed., p. 599.

Texier J.P., Lefevre D., Raynal J.P. (1992) - La Formation de la Mamora. Le point sur la question du Moulouyen et du Salétien du Maroc Nord-Occidental. *Quaternaire* 3(2):63-73.

Texier J.P., Lefevre D., Raynal J.P., El Graoui M. (2002) - Lithostratigraphy of the littoral deposits of the last one million years in the Casablanca region (Maroc). *Quaternaire* 13(1):23-41.

Texier P.J. (1995) - The Oldowan assemblage from NY 18 site at Nyabusosi (Toro-Uganda). *C. R. Acad. Sci. Paris, series 2A, Sciences de la terre et des planètes* 320:647-653.

Tixier J. (1956) - Le hachereau dans l'Acheuléen nord-africain. Notes typologiques. In: *Proceedings of the XV Session of the Congrès Préhistorique de France,* July 15-22. Poitiers-Angoulême, p. 914-923.

Torre I. de la (2004) - Omo revisited evaluating the technological skills of Pliocene hominids. *Current Anthropology* 45:439-465.

Woldegabriel G., White T., Suwa G., Semaw S., Beyene Y., Asfaw B., Walter R. (1992) - Kesem-Kebena: a newly discovered paleoanthropological research area in Ethiopia. *J. Field Archaeol.* 19:471-493.